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Short Note

Ingestion of Invertebrates, Seeds, and Plastic by the Amazonian Manatee (*Trichechus inunguis*) (Mammalia, Sirenia)

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The living Sirenia belong to the only group of herbivorous aquatic mammals which occur in river systems and coastal tropical and subtropical waters (Ronald et al., 1978). From this group, the Amazonian manatee (*Trichechus inunguis*) is the smallest species, exclusively from freshwater and endemic to the Amazon Basin (Rosas, 1994). Sirenians are monogastric herbivores with post-gastric digestion and a low metabolic rate (Best, 1981). Aquatic and semi-aquatic macrophytes are the main food source for Amazonian manatees, and the species composition and abundance of these plants are strongly influenced by the Amazonian hydrological pulse, which consequently influences the annual supply of food for the manatees (Best, 1981; Rosas, 1994).

Apparently opportunistic, the Amazonian manatee consumes a great diversity of aquatic vegetal species according to the availability in the environment, especially *Paspalum repens, Echinochloa polystachya* (Best, 1981; Montgomery et al., 1981; Colares & Colares, 2002; Guterres-Pazin et al., in prep.), *Hymenachne amplexicaulis, Oryza grandiglumis, Azolla caroliniana*, and *Limnobium spongia* (Guterres-Pazin et al., in prep.).

Manatees may consume considerable amounts of small invertebrates and algae that live in the roots and leaves of aquatic macrophytes (Best, 1981; Ledder, 1986; Colares & Colares, 2002). Although accidentally ingested, these materials are believed to serve as a source of protein or nutritional supplement in the diet of the species (Hartman, 1971, 1979; Best, 1981; Packard, 1981). Manatees have also been reported to opportunistically ingest gillnet-caught fish in Jamaica (Powell, 1978) and chew on crustaceans, mollusks, and tunicates off a wooden dock in Florida (Courbis & Worthy, 2003). A high number of tunicates (up to approximately 4,000) found in the gastrointestinal tracts of manatees that died during a red tide event suggests ingestion of invertebrates may be purposeful (O'Shea et al., 1991). In an effort to document Amazonian manatees' feeding habits in the area of the mid-Solimões River (Brazil), we came upon some unusual items, which are described herein. In this study, we analyzed a total of 230 fecal samples found floating and 16 stomach contents of Amazonian manatees hunted or incidentally caught between 1993 and 2008 in the Mamirauá Sustainable Development Reserve (MSDR) (03º 01'10.2" S, 64° 53'43.9" W) and the Amanã Sustainable Development Reserve (ASDR) (02° 42'25.6" S, 64° 37'06.5" W), in Central Brazilian Amazon. For the identification of the plant material consumed by the Amazonian manatee, the method by Hurst & Beck (1988) was adapted and modified to simplify the analysis. Fecal and stomach content samples were homogenized in 70% alcohol. From each sample, 10 1-ml subsamples were taken and filtered in 35- and 120-mesh screens. This material was again subsampled, and a drop was placed on a microscopic slide and topped with a 22 × 22 mm cover slip for microscopic analysis. This procedure was repeated five times for each fecal and stomach content sample.

The results revealed the presence of arachnids (Araneae) and zooplankton (Protozoa, Rotifera, Cladocera, and Copepoda) in 14.6% (n = 36) of the samples, as well as sand and other unidentified materials. All invertebrates were found intact, undigested by the manatee. This fact corroborates the information given by Best (1981) and Colares & Colares (2002) on the accidental ingestion, but it demonstrates that arachnids and zooplankton, in contrast to the hypothesis suggested by Best

(1981), do not represent a nutritional supplement in the diet of the Amazonian manatee. Seeds of grasses (Poaceae) were also present in 20 samples (2 stomachs and 18 feces), and 75% of them were broken. According to Colares & Colares (2002), who also identified broken seeds in the diet of the species, the Amazonian manatee is probably not a good disperser of grasses because most seeds are not egested intact. On the other hand, plant seeds may represent an additional source of nutrients as exemplified by O'Shea's (1986) account of Florida manatees foraging on mast.

In one of the fecal samples analyzed in this study, collected in 2006 in MSDR, a piece of plastic was found completely chewed, but judging by its small size (5 × 2 cm), it probably did not cause direct harm to the animal. However, the plastic found in the sample may have been only a portion of the ingested material since the animal can eliminate the material slowly as observed by Attademo et al. (2008) in *Trichechus manatus manatus*. These authors reported that a manatee on the northeastern coast of Brazil, weakened by the ingestion of plastic materials, expelled plastic parts in the feces during 60 nonconsecutive days. In the same study, they reported the death of another animal due to blockage of the stomach and intestines caused by ingestion of plastic. Silva & Marmontel (2009) reported the death of an Amazonian manatee in MSDR in which the cause of death was associated with the presence of a plastic bag in the stomach. In Florida, Beck & Barros (1991) reported the ingestion of plastic materials (such as lines and fishing nets, plastic bags, rope, string, cellophane, synthetic sponges, and more) in 63 Florida manatees (*T. m. latirostris*). Four of them eventually died as a direct result of ingestion of plastic. In 1985, also in Florida, the ingestion of plastic blocked the digestive tract of a *T. m. latirostris*, resulting in death (Laist, 1987). Plastics have been ingested by a range of aquatic animals, from invertebrates to mammals (Thompson, 2007). The effects of plastic materials on the biota of the marine environment were reviewed by Derraik (2002) and Gregory (2009).

As the Amazonian manatee consumes a large amount of plants, often in mixed macrophyte banks where part of the ingested material is not viewed by the species because it is above the water surface or among leaves and roots, it is certain that the manatee accidentally consumes microorganisms, seeds, and other items that are not part of its normal diet, as well as plastics that can be trapped in these macrophyte banks.

As accidental ingestion of microorganisms and seeds does not affect the health of the manatee even when not digested, the major concern is centered on the growing process of environmental degradation, mainly caused by indirect and direct deposition of waste (including plastic) in the rivers of the Amazon. This waste can be ingested by manatees, often causing death and consequently increasing the already long list of threats to the species.

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